

CERTIFIED AGGREGATE PRODUCER PROGRAM

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The Indiana Department of Transportation (INDOT), Federal Highway Administration (FHWA), and the Indiana Mineral Aggregates Association (IMAA) have joined in a partnership to provide the Quality Control/Quality Assurance (QC/QA) concept to mineral aggregates. INDOT currently has many QC/QA projects for hot mix asphalt, pavement concrete, and superstructure concrete and a limited number of warranty, design-build, contractor tests for acceptance, hot mix asphalt volumetric, and concrete performance-related specification projects. All of these specifications rely to a great extent on uniform and consistent materials to assure a quality end product. The goal of the QC/QA specification for aggregates is to improve the consistency of the material so that a quality product can be obtained.

The procedure used by INDOT in the past to accept aggregates required that a stockpile of aggregates be tested to verify compliance with specifications, and the stockpile subsequently approved or disapproved prior to shipment. This pass/fail specification became very confrontational with Producers when failing tests were obtained and shipments delayed or stopped to active contracts. Even when eventually resolved, project delays were inevitable in many cases. A QC/QA procedure whereby Producer's tests could be used for acceptance, and shipments of aggregates made on demand was needed. The Certified Aggregate Producer Program (CAPP) was introduced as the procedure to accomplish both needs.

PROGRAM DEVELOPMENT

The development of the CAPP began with the formation of a joint committee of members from INDOT, FHWA, and the IMAA. The task of the group was to establish the minimum requirements of the program and to begin a dialog that would lead to a mutual trust between the two parties. The initial step in the process was a Coordinated Testing Program that was considered an intermediate program leading to the adoption of the CAPP. During this phase there was an expansion of mutual knowledge of the production capability, capacity, uniformity, and quality of aggregates and the formulation of a statistical data base. Seventeen Producers volunteered to participate in the Coordinated Testing Phase. Samples were randomly obtained by the Producers and tested by the Producers and INDOT. Producer documentation of samples taken, test results, corrective action taken for results out of tolerance, and source ledge or deposit changes were required. Test data was plotted on control charts to provide a graphical record of aggregate gradation during production and after stockpiling.

In general, results from the Coordinated Testing Phase indicated that Producers were capable of controlling production, stockpiling, and shipping so that a statistical approach could be applied for control of aggregate gradation. A maximum standard deviation of 5.0 was selected for the primary control sieve of each coarse aggregate product. Control limits of $\pm 2 \sigma$ with a maximum of ± 10.0 from the target mean, were established to assure a 95 percent compliance rate.

PROGRAM REQUIREMENTS

Upon completion of the Coordinated Testing Phase, the guidelines of the CAPP were jointly established by INDOT, FHWA, and the IMAA. The program sets minimum requirements for sampling and testing for gradation, decant, deleterious, and coarse aggregate angularity, if applicable. Acceptance limits are set for all test results and the Producer is required to take corrective action when limits are exceeded. A site-specific Quality Control Plan that designates the source's process control procedures necessary to assure product compliance with acceptance limits is the main focus of the CAPP. The major items that the Producer is required to address in the Quality Control Plan include:

- **Production Flow Diagram.** The production flow diagram is a written description or flow chart of a general nature showing all of the points involved with mining and processing the material from the natural deposit to the finished product. The flow diagram is used to locate areas in the processing of the aggregate that may be improved to provide a more consistent material. Changes in the process are recorded, and the resulting possible change in gradation can be easily determined.
- **Stockpiling and Load-Out Procedures.** The procedures for stockpiling and loading-out aggregates is required to be stated so that segregation of material is kept to a minimum. Also, safeguards are identified to prevent loading improper materials and contamination of material. These requirements assure that the loader operators become an integral part of the overall process control of the material.
- **Equipment Calibration.** The procedures for verifying the calibration of testing equipment and the frequencies of such verifications are required to be stated. Test methods for verification were developed by INDOT for balances, mechanical shakers, sieves, and ovens and both INDOT and Producers perform these verifications at the same minimum frequencies. The validity of test results of both parties is thus further reinforced with assurance that the testing equipment is functioning properly.
- **Sampling and Testing Procedures.** The sampling locations and sampling, sample reduction, and testing procedures are required to be identified. AASHTO and INDOT test methods are required to be used for these procedures, with the exception of the production sampling within the processing plant which may be at the Producers discretion, if approved by INDOT. Standardized procedures, like testing equipment verifications, ensure accurate and reproducible test data so that process control decisions can accurately be made.
- **Control Charts.** The procedure for charting gradation test data for each Certified material is required. As a minimum these charts are required to contain the target mean for coarse aggregate products, the control limits, and the moving average of the last five data points. This graphical representation of test data is a valuable resource for identifying trends in the gradation at an early stage that may be used to prevent eventual non-complying material. Also, the charts are quick references for customers, such as HMA and Concrete Producers, that may be used to identify changes in materials that may have occurred since an original mix design using the material was performed.

- **Daily Diary.** The procedures for maintenance of a diary to document significant events at the aggregate source is required. As a minimum the diary is required to contain any major plant changes that may have an effect on the gradation of the material. Also, the corrective actions taken by the Producer for non-complying test data is documented. With this information, the Producer can begin to develop the relationship between plant changes and the end-product, and build a history of corrective actions taken to resolve inconsistencies in the gradation of each material.

The Producer is required to proceed through a Coordinated Testing Phase and a Trial Phase before becoming Certified. The Coordinated Testing Phase is the initial phase whereby the Producer develops the details of the Quality Control Plan and demonstrates the ability to produce to the 95 percent compliance standard. Mean test values and standard deviations for the Certified Materials are developed during this period.

The Trial Phase is the second phase for Certification. This phase is started when the Producer has successfully completed the Coordinated Testing Phase and the Quality Control Plan has been approved. During this phase the Producer demonstrates the ability to follow the Quality Control Plan.

When the Producer and INDOT are satisfied with the Trial Phase an audit is scheduled. The audit verifies that the Producer is following the Quality Control Plan, and additional checks on sampling and testing procedures are made. Upon resolution of any problems arising during the audit and with a favorable recommendation, the Producer becomes Certified.

Once certified, the Producer is allowed to ship material on demand, and acceptance by INDOT is based on the Producer's test results. Verification of compliance with the CAPP is done by INDOT with an audit system. Assurances that the Quality Control Plan is being followed is the main focus of the audits. The sampling, sample reduction, and testing procedures of the Producer are monitored for compliance by checklists that were developed by INDOT. Finally, samples are obtained, split, and tested by both the Producer and INDOT, and a comparison to an acceptable precision is made.

TRAINING

With the introduction of any Quality Control/Quality Assurance program, there is a need to address the proper training of personnel involved with the Program. This was accomplished with the CAPP by a Certified Technician Program conducted by INDOT and the IMAA. Twenty representatives from industry and 15 representatives from INDOT and educational institutions participate in the training. In addition to the requirements of the CAPP, information pertaining to the origin of aggregates in Indiana, quality testing of aggregates, and aggregate processing are presented. Currently approximately 500 individuals are qualified as Certified Technicians. Additional training sessions related to the technician course include:

- **Executive Conference.** This conference was a one-day informational meeting sponsored by the IMAA to present an overview of the CAPP to aggregate Producers. It was intended to inform non-technical aggregate personnel about the CAPP and explain how the Program will affect their daily operation of the plant and quality of the aggregate produced.

- **Pre-CAPP Workshop.** This one-day training session is offered each year prior to the Certified Aggregate Training course. It is designed to introduce individuals new to the industry to the terminology and techniques of aggregate testing. In addition to hands-on experience with the basic aggregate tests, a field trip to an active quarry to observe operations and testing laboratory layout is included.
- **Recertification Refresher Course.** This one-day training session is offered for Certified Technicians required to become recertified and who may not have been involved with the day-to-day testing of the CAPP. Specifics of aggregate testing and statistical concepts, and an update of the CAPP is presented. Since many Certified Technicians are in managerial positions, this course has become very valuable for those individuals to keep abreast of this dynamic program.

Although INDOT technicians do not attend the above-noted training sessions because of INDOT's own Certification Training Program, the concepts of the CAPP are presented in their training sessions. The training manual developed for the CAPP course is used for the INDOT training, and the certification exam is comparable to that used in the CAPP.

Funds generated from the CAPP training sessions have been used to sponsor additional workshops for INDOT and industry certified technicians. Two workshops have been conducted to further knowledge of identification of deleterious materials. Instructors have included representatives from INDOT, FHWA, Industry, Purdue University, and Indiana University for these workshops. Also, the IMAA has sponsored a safety workshop for INDOT technicians. With increased exposure to quarry and pit operations because of audit requirements, there was concern that INDOT employees be aware of the hazards that are inherent to aggregate production.

BENEFITS

Currently there are 213 sources that are permitted to supply aggregates as Certified Aggregate Producers for use on Indiana projects. Several sources are in preliminary phases of the CAPP and expect to be certified in the year 2004. Since inception of the mandatory requirement in 1997 which involved some exceptions for initiation of the Program, this Program was fully enforced in 1998-1999. The goals of the Program to maximize uniformity of aggregates and enable shipment of materials when needed have been obtained. Specific benefits of the Program for Producers include:

- Producers have detailed knowledge of the effect of plant production on the consistency of the aggregate products.
- Uniformity can be increased while maintaining or even advancing profit margin.
- The Program instills and/or perpetuates a sense of quality and responsibility to the Producer.

- Producers can better serve customers, such as HMA and Concrete Producers, by providing test data relevant to mix designs for their products. Problems that may occur due to inconsistent gradations can be quickly traced with information readily available on the gradation, stockpiling procedures, load-out procedures, or any specific problems that may have occurred at the aggregate source.
- Producers can provide test data to non-INDOT customers, such as local agencies and private industry, to assure them of the quality of product they are receiving.

For INDOT the benefits other than the obvious benefit of receiving consistent aggregate products include:

- Historical data is developed on individual Producers as well as the industry statewide.
- Detailed knowledge of regional characteristics and differences in aggregate materials is obtained.
- The critical time scheduling for pre-ship approval has been eliminated. Utilization of INDOT technicians for auditing and other duties has been greatly improved.
- INDOT has developed an enhanced understanding and appreciation of aggregate characteristics and requirements.
- The CAPP provides a primary analysis source point for future revisions to aggregate specifications and requirements.
- INDOT has reduced quality testing on aggregate sources from 325 sources in 1997 to currently approximately 230 sources. This reduction in sources has resulted in substantial savings of time and money.

As we approach increased Quality Control for all transportation materials, more and more emphasis will be placed on the raw components that comprise those materials. By realizing that aggregates comprise approximately 95 percent by weight of HMA and 75 percent by volume of concrete, it is obvious that this product has a major impact on the performance of the end product. Although consistent aggregate products are no guarantee that a quality product will be obtained, we know that the level of excellence we are striving for cannot be achieved without the good building blocks that consistent aggregate products can provide. The Certified Aggregate Producer Program is the means to give us that start to excellence.